

BIOLOGICAL EVALUATION
SPRUCE BUDWORM INFESTATIONS

Larval Density and Damage Surveys
Carson and Santa Fe National Forest
1961

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Plans were made in 1959 to develop a method for making biological evaluations of spruce budworm infestations.^{1/} The plans included a fall survey of new and old egg masses, a spring survey of immature larvae that survived the winter, and a summer survey of defoliation of new growth. It takes parts of two field seasons to accomplish all three of these surveys. This report covers the larval and defoliation survey done during the spring and summer of 1961. The egg mass survey was done in the fall of 1960.^{2/} The purpose of this report is to show the association between fall egg mass densities, spring larval abundance and defoliation of new growth.

EVALUATION PROCEDURES

Larval Surveys: Larval counts are made to determine the population density when feeding begins. The survey was begun when second instar larvae were attacking the expanding buds and ceased when the larvae reached the fourth instar. Unfortunately, this limits the time of sampling to a two to three week period. Because of this short period and limited manpower, only nine of the egg mass plots of the previous fall were taken.

Each larval survey plot consisted of 25 dominant or codominant Douglas-fir trees. The sampling unit was a 15-inch twig taken from each of four sides of the lower crown of each tree. Larvae

^{1/} Pierce, D. A. Biological Evaluation of Spruce Budworm - Work Plan. 1959. Rocky Mountain Forest and Range Experiment Station. Unpublished.

^{2/} Chansler, J. F. Biological Evaluation, Spruce Budworm Infestation, 1960. Carson and Santa Fe National Forests. Unpublished.

and buds per 15-inch twig were counted. A pole pruner equipped with a basket was used to cut the twigs from the trees. The trees were numbered with paint so they could be located easily during the damage survey.

Damage Survey: After feeding had stopped, the larval survey plots plus three other egg mass plots were revisited and ocular estimates of current defoliation were made. Damage survey plots consisted of 25 dominant or codominant Douglas-fir trees. The same 25 trees were used on plots where larval counts were made. The crown of each tree was visually divided into thirds and examined by two men using 67X15 binoculars. The men made individual estimates of percent of current defoliation for each crown third. The top third was weighted by one, the middle third by three, and the bottom third by five. This damage appraisal method was based on a study made in the Pacific Northwest.

RESULTS

Larval Survey: Immature larvae were counted per 1000 buds and per 15-inch twig. The average number of larvae per 1000 buds for the nine plots ranged from 17.9 to 110.0, while the average number of larvae per 15-inch twig ranged from 1.8 to 10.4. Average number of larvae per 1000 buds and 15-inch twigs by plots are shown in the following tabulation:

<u>Plot</u>	<u>Larvae per 1000 buds</u>	<u>Larvae per 15-inch twig</u>
Bluebird Mesa	17.9	1.76
La Jara Canyon	63.7	4.57
Del Norte Canyon	66.6	4.89
Clear Creek	66.8	3.80
La Junta Canyon	96.7	7.10
Pot Creek	103.6	8.05
Pelleo Canyon	104.3	10.36
Rio Nutritos	115.7	5.94
Willow Creek	110.0	8.31

Ratios of the two measurements are generally similar; Clear Creek and Rio Nutritos appear to be the most outstanding exceptions. The methods of measuring larval populations will be compared to determine which is best for predicting damage.

3/ Carolyn, V. A. and H. K. Colter. 1959. Research findings relative to the biological evaluation of spruce budworm damage evaluations in Oregon. Pacific Northwest Forest and Range Experiment Station. Unpublished.

Damage Survey: Current percent defoliation on the 25 trees was averaged for each plot. Average percent defoliation in the plots ranged from 8.1 at Bluebird Mesa to 49.7 at Rio Huerfano. Percent of current defoliation by plots is as follows:

<u>Plot</u>	<u>Percent current defoliation</u>
Bluebird Mesa	8.1
Clear Creek	12.6
Del Norte Canyon	12.9
La Junta Canyon	23.1
La Jara Canyon	36.1
Garcia Park	41.3
Consuelo Creek	45.0
Texas Canyon	45.7
Pot Creek	47.7
Palo Quemado Canyon	49.8
Rio Huerfano	49.7

DISCUSSION AND SUMMARY

The methods described to measure immature larval densities have been tested by researchers from other areas in the West. In the Pacific Northwest larvae per 1000 buds proved to be most useful whereas in the Intermountain area larvae per 15-inch twig is used. The following is part of a table constructed by entomologists for use in eastern Oregon. 2/3

<u>Number of larvae per 1000 buds</u>	<u>Percent defoliation</u>
50	15
51 - 150	15 - 25
151 - 300	25 - 50

The nine larval survey plots in northern New Mexico had an average of 87 larvae per 1000 buds and the defoliation averaged nearly 34 percent (Table 1). Eight of the plots had between 51 and 150 larvae per 1000 buds. It can be seen that the above partial table tends to under estimate expected damage in the Southwest.

2/ Carolin, V. A. and W. H. Collier. Op. cit., p. 2

3/ Cole, V. J. Spruce budworm population - damage study. 1960 Progress Report. Intermountain Forest and Range Experiment Station. Unpublished.

Table 1.—Relationship between 1960 egg mass densities, 1961 larval densities and 1961 defoliation for spruce budworm populations at 12 plots in northern New Mexico.

Plot	: Egg masses per : 1000 sq. in. : of foliage : Fall - 1960	: Larvae per : 1000 buds : Spring-1961	: Larvae per : 15-inch twig : Spring-1961	: Percent : current : defoliation : 1961
Clear Creek	3.6	86.8	3.80	12.6
Del Norte Canyon	6.8	66.4	4.64	12.9
Bluebird Mesa	12.9	17.9	1.76	8.1
Taos Canyon	16.3	—	—	45.7
La Jara Canyon	17.5	63.7	4.57	36.4
Pellico Canyon	24.3	154.3	10.34	49.8
Rio Nutritos	30.5	115.7	5.94	54.7
La Junta Canyon	31.4	86.7	7.10	29.1
Garcia Park	32.3	—	—	41.3
Willow Creek	46.2	140.0	8.34	57.4
Comales Creek	51.4	—	—	45.0
Fot Creek	52.7	103.6	8.05	47.7

Entomologists in the Intermountain area constructed the following tabulation for field use:

<u>Average number of larvae per 15-inch twig</u>	<u>Expected percent of defoliation</u>
1 - 5	25
6 - 8	25 - 50
9 - 10	50 - 75

Except for the plots at La Jara Canyon and Rio Nutritos the data from Region 1 and Region 3 closely compare.

For the limited number of plots surveyed, the two methods of measuring larval densities give generally similar results. It cannot be said which method of measuring larval densities is best until more data is accumulated.

In table 1 two defoliation classes are apparent: light defoliation on the Clear Creek, Del Norte Canyon and Bluebird Mesa plots; moderate damage on the other plots. The data from the plots are grouped according to these defoliation classes and their ranges are given in table 2.

Fall egg mass densities per 1000 square inches of foliage ranged from 3.6 at Clear Creek to 52.7 at Pet Creek. As expected, egg mass densities increase as larval densities and defoliation increase. The relation between larval populations and damage is fairly substantial. However, the relation between egg mass densities and larval densities is uncertain. Based on the evidence thus far accumulated, light defoliation can be expected from egg mass counts below 15 per 1000 square inches of foliage, and moderate defoliation when the density averages between 15 and 40. Heavier defoliation will occur as the egg mass density increases.

CONCLUSIONS

This evaluation has provided basic information for better understanding the biological factors influencing spruce budworm populations in Region 3. Egg mass density per unit of foliage used alone or in conjunction with a larval survey shows promise as a tool for predicting budworm-caused damage.

The ability to predict the trend of spruce budworm infestations in the Southwest will improve as added information becomes available from future biological evaluations. The data obtained from this first complete evaluation are being used to interpret the results of the 1961 egg mass survey.

Table 2.--Summary of egg mass, larval, and defoliation survey data from nine plots in northern New Mexico.

Egg masses per 1000 sq. in. of foliage	Larvae per 1000 buds	Larvae per 15-inch twig	Percent current defoliation
3.6 - 12.9	17.9 - 86.8	1.8 - 4.8	8.1 - 22.9
16.3 - 52.7	63.7 - 110.0	4.6 - 10.3	29.1 - 54.7